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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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09/825,875

04/03/2001

Sarath D. Gunapala

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EXAMINER

KANG, DONGHEE

ART UNIT

PAPER NUMBER

2811

DATE MAILED: 03/05/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/825,875

Applicant(s)

GUNAPALA ET AL.

Examiner

Donghee Kang

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 27 November 2002.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 2-41, 43-73 and 75-89 is/are pending in the application.
- 4a) Of the above claim(s) 2-40, 68-70 and 84-89 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 41, 43-67, 71-73 and 75-83 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____
- 4) ☐ Interview Summary (PTO-413) Paper No(s). _____
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____

DETAILED ACTION

Acknowledgment

1. Applicant's amendment and response to Paper no.8 has been entered and made of record. Claims 42 & 74 have been cancelled.

Claim Rejections - 35 USC § 102

2. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

3. Claim **41 & 43-46** are rejected under 35 U.S.C. 102(b) as being anticipated by Bethea et al. (US 5,023,685).

Regarding claim **41**, Bethea et al. teach a semiconductor, comprising (Fig.2):

a plurality of quantum well elements (21), each with a well layer having a well bottom, a well top, and bound energy states (24) within said well, and first and second barrier layers (22) surrounding said well layer, said well layers being formed of materials that cause a bound energy state to be resonant with said well top, at a level that allows an electron in said well to escape to an electron continuum area of higher energy state electrons, without tunneling through material forming said barrier layers. See *also Col.3, lines 45-53*.

Regarding claim **43**, Bethea et al. teach the semiconductor device further comprising an element that adjusts a direction of input radiation, relative to said quantum well elements (see Fig.1 & Col.3, lines 37-38).

Regarding claim **44**, Bethea et al. teach the semiconductor device further comprising electrical contact layers (12 & 14, Fig.1) on a first side of said quantum well elements, and a second electrical contact layer on a second side of said quantum well elements.

Regarding claim **45**, Bethea et al. teach that a roughened surface can be used for coupling (Fig.6 & Col.4, lines 15-21).

Regarding claim **46**, Bethea et al. teach the semiconductor device further comprising a plurality of image sensors, arranged in an array (Fig.6).

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

5. Claims **47-73 & 75-83** are rejected under 35 U.S.C. 103(a) as being unpatentable over Bethea et al. (US 5,023,685) in view of Kozlowski (Electron Device, Vol.38 (5), May 1991).

Regarding claims **47-48, 51-53 & 56**, Bethea et al. teach that plurality of quantum well elements are arranged into a plurality of quantum well stacks, each quantum well stack including a plurality of periods, each period comprising a well layer and first and second barrier layer (Fig.6). Bethea et al. do not expressly teach each quantum well stacks associated with one of said image sensor. However, Kozlowski teaches forming hybrid focal plane array by mating the silicon CMOS readouts to the GaAs detector

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array via indium interconnects (Fig.10 & Part III. 128 × 128 CMOS Readout on Page 1127). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to fabricate hybrid FPA by mating the silicon CMOS readouts to the GaAs detector array, since QWIP FPA provides a better performance compared with other FPA technologies.

Regarding claims **49-50 & 77-78**, Bethea et al. do not teach a plurality of bumps, connecting between said quantum well stacks and said image sensor, wherein said image sensor are CMOS image sensor. However, Kozlowski in Fig.10 teaches indium bump is formed between detector array and Si readout circuit. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to form indium bump in order to provide an interconnection between detector array and Si readout circuit.

Regarding claims **54, 57 & 73**, Bethea et al. as modified by Kozlowski teach image sensors having a peak sensitivity in the infrared region (Fig.4).

Regarding claim **55**, Bethea et al. as modified by Kozlowski teach the well layer is formed of GaAs (Col.5, line 3).

Regarding claims **58 & 79**, Bethea et al. as modified by Kozlowski teach radiation direction adjust element that adjust a direction of input radiation relative to said quantum well stacks (see Fig.1 & Col.3, lines 37-38).

Regarding claim **61**, Bethea et al. as modified by Kozlowski teach a plurality of electrical contacts, associated with said semiconductor (Fig.1).

Regarding claims **64 & 76**, Bethea et al. as modified by Kozlowski teach that there are 50 of said quantum well structure in each of said quantum well stacks (Col.6, lines 22-23).

Regarding claims **65 & 83**, Bethea et al. as modified by Kozlowski teach the well layers are formed of GaAs and the barrier layers are formed of AlGaAs (Col.5, lines 1-5).

Regarding claim **66 & 75**, Bethea et al. as modified by Kozlowski teach said image sensor having a peak reception about at 8.5 micron (see Fig.4).

Regarding claims **71 & 73**, Bethea et al. teach a semiconductor, comprising (Fig.6):

a plurality of quantum well stacks (61), each said stack comprising a plurality of quantum well structures, each said quantum well structure having a barrier layer (22, Fig.2) of a first semiconductor material (AlGaAs, Col.5, line 4) that is at least greater than 200 angstroms (Col.5, lines 7) in width, and a well layer of a second semiconductor material (GaAs, Col.5, line2), said first and second semiconductor materials defining a band gap therebetween, each well layer of each quantum well structure coupled between two of said barrier layers, and each well layer having a well bottom and a well top, wherein each well (21) supporting an unexcited energy state within said well, and a bound excited energy state (24) for photo carriers, each of said well layers being selected each that the bound excited energy state is resonant with a top portion of the well.

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Bethea et al. do not expressly teach each quantum well stacks associated with one of said image sensor. However, Kozlowski teaches forming hybrid focal plane array by mating the silicon CMOS readouts to the GaAs detector array via indium interconnects (Fig.10 & Part III. 128 × 128 CMOS Readout on Page 1127). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to fabricate hybrid FPA by mating the silicon CMOS readouts to the GaAs detector array, since QWIP FPA provides a better performance compared with other FPA technologies.

Regarding claims **59, 62-63, & 80**, Bethea et al. as modified by Kozlowski teach random reflector (61) to adjust directing of radiation (Fig.6).

Regarding claims **60 & 81-82**, neither Bethea et al. nor Kozlowski teach the random reflectors are formed of gold or silver. However, it would have been obvious to one having ordinary skill in the art at the time the invention was made to form the random reflector, having the material claimed, since it has been held to be within the general skill of a worker in the art to select a known material on the basis of its suitability for the intended use as matter of obvious design choice. In re Leshin, 125 USPQ 416.

6. Claim **67** is rejected under 35 U.S.C. 103(a) as being unpatentable over Bethea et al. (US 5,023,685) in view of Kozlowski, as applied to claim 56 above, and further in view of Yoshida (US 5,307,200).

Neither Bethea nor Kozlowski teaches said quantum well is formed of $\text{Al}_y\text{Ga}_{1-y}\text{As}$ and said barrier layer is formed of $\text{Al}_x\text{Ga}_{1-x}\text{As}$ layer. Yoshida teaches the quantum

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well structure comprising a AlGaAs well layer and AlGaAs barrier layer (Col.11, lines 18-20). It would have been obvious to one of ordinary skill in the art at the time the invention was made to substitute the quantum well structure (AlGaAs/AlGaAs) as taught by Yoshida with a quantum well structure (GaAs/AlGaAs) of Bethea since the AlGaAs/AlGaAs quantum well structure would provide a good lattice match compared GaAs/AlGaAs quantum well structure.

Response to Arguments

7. Applicant's arguments with respect to claims 41, 43-73, & 75-83 have been considered but are moot in view of the new ground(s) of rejection.

Conclusion

8. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

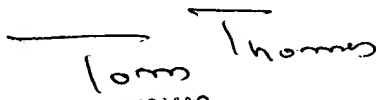
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9. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Donghee Kang whose telephone number is 703-305-9147. The examiner can normally be reached on Monday through Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Tom Thomas can be reached on 703-308-2772. The fax phone numbers for the organization where this application or proceeding is assigned are 703-308-7722 for regular communications and 703-308-7722 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0956.

dhk
February 25, 2003


TOM THOMAS
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 2800